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Bats and Rats
Studying Real vamps upside down

Srishti Gaur
MBBS 2nd Prof student , PGIMS, Rohtak

Abstract
Zoonotic spread of the diseases have witnessed a lot of outbreaks ever since history. It's a close association of man with its environmental friends and foes that lead us into peril many a times. Two of these animals that are in spotlight since history and present time are bats and rats. Rats despite of their small size have proved that they are not to be underestimated for their size as they can swipe up more than half of the world's population as has happened during the times of Black Death and great plagues, denting some dark periods of gloom in the glory of history. While industrialisation in its early days give birth to public health , its credentials have been put into check time to time proving Homo sapiens, the so called superior mammals that they have overestimated themselves. As the modern society sets , bats, the so called flying relatives of rodents in accordance to now obsolete flying theory have shown they are no less than their relatives. Revolving around immunology and genetics we sought to answer curiosity of mankind and put new questions in the scene.
Keyword:- *COVID-19, immunology , genetics, zoonosis, coronavirus*
Methodology:- *it is an exploratory study of secondary resources, analysing the data from reliable and authentic sources*
Shortcoming:- *the research is not a primary work of the researcher but an analysis of the available information*

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I. Introduction

Bats have shown their marks throughout the literature, fantasy and horror after Bram Stokers masterpiece *Dracula.* They are seen as the evil animals of deaths and curse of a supernatural existence

Past is glorified around the in and out of these caped little devils , incorporated in books, movies, legends and what not. While the fantasy world has long accepted bats as the carriers of death and hauntings science is bending on the same rails since a decade or so. The danger these creatures losses is now becoming reality giving us a more brutal picture of what we have read , seen and imagine. Almost all the deadly and fatal outbreaks of 21stCentury are somehow related to the bats . The fantasy beast of death are being the crux vamps

of morbid and mortal. Not even the charisma of batman who made this devil a superhero could dispel the basic human wariness of bats.

While the bats are still new to step out of the fantasy and haunt the real world there's been an another little Devil having the crown of this dead race since last few centuries, Black Death, great plagues to name a few.

Considering all other existence inferior to us since time unknown have failed to account the caliber of these foot sized or palm sized beings, but history has proven us wrong in underestimating these rodents.

Quite commonly spotted in household but these ratty rats have changed the course of history, have turned the world upside down and have proved that they have a capability to end human life .

But the point why we are concerned so much about them is because they are a necessary evil with rats marking the history and bats laying the foundation of a new world of terror we set to discover the hidden secrets of nature, climate, diversity and creatures.

II. Trade of Lives

Grain ships sailed across the Indian Ocean from Central Asia to Europe but before they could be unloaded at the harbors of a merry world the whole port or rather I should say whole city gasped , for what they had witnessed couldn't be real ! More than half of the people on the ship were dead and those who survived were bleeding with blisters and a foul smelling pus oozing out of them. Before the people could react and send the ship back, the disease spread like a wildfire all across the country and people started falling Ill , being dead like they were never alive before. The illness swept more than half of the population of that time, the person who's perfectly fine one day could be dead by the next day, and that's how *Black Death* stepped in mercilessly killing 60% of Europe's population by then.

Soon the government after realizing the reason behind the pestilence was rats announced a cash prize of 19 cents for every rat brought to then, dead or alive.

No one knew exactly how the Black Death was transmitted from one patient to another, and no one knew how to prevent or treat it. According to one doctor, for example, "instantaneous death occurs when the aerial spirit escaping from the eyes of the sick man strikes the healthy person standing near and looking at the sick."

The French biologist Alexandre Yersin discovered this germ at the end of the 19th century.

They know that the bacillus travels from person to person through the air, as well as through the bite of infected fleas and rats. Both of these pests could be found almost everywhere in medieval Europe, but they were particularly at home aboard ships of all kinds—which is how the deadly plague made its way through one European port city after another.

Today, this grim sequence of events is terrifying but comprehensible. In the middle of the 14th century, however, there seemed to be no rational explanation for it.

Though Black Plague was a turning point in the history it is not the only disease cause by rats or for a generalised term let's say rodents, are known to cause various other diseases as well salmonellosis, leptospirosis and hemorrhagic fever to name a few.

Worship and wasting

While Europeans have developed a disgust for these rodents Indians still worship them considering then vehicle of Lord Ganesha. Rats king "Muskaraja" has been given special place in religious scriptures giving high regard to these petty animals. To this day, with well established pestilence of rats there's a whole temple dedicated to rats in Bikaner, Rajasthan. The *Karni Mata Mandir*,is famous for 25,000 black rats that live and are revered in the temple. These holy rats are called *Kabbas* and many people travel long distances to pay their respects. The temple draws visitors all across the country for blessings and curious tourists all over the world.

Legend has it that eating food *that has been nibbled* by these rats is considered to be a "high honour".

Just imagine the rats that have caused so many great pandemics by consuming food that's just being touched by these rats or their droppings , how would it affect a person who willingly eats the food fed to rats first.

Despite of rats spoil I gotta crops, littering storage and warehouses, they are still worshipped in Hindu society, ironically, as forebringer of good fortune

Why do rats cause so many infectious diseases?

Pretty much rats carry various disease just like cats, dogs and even humans. They are social animals they live in groups and contact many others. One diseased rat can spread it to their whole community just like we humans can transmit diseases by direct and indirect contact.

Rats live in damp, dark and dirty places which are known to be breeding grounds for most of the small insects, vertebrates and invertebrates but it's their high reproductive capacity and more integrated involvement in community especially in the rural areas thathave led to their such a large impact in social aspects of health and diseases.

The less life span of these is also a reason behind their pathogenicity. They hide in the dark hooks of household and godowns where they die and the dead carcass decay in the gloom imprinting culture for more infective pathogens.

To this day around 35 diseases are there that are known to be spread by the rats however mechanism of each of then is still not clear.

Prevention and control

After the establishment of the proper health institutions with a more scientific temperament,the awareness about health, hygiene, distancing with animals, and pest control came into being. People all around the world were now focusing on a clean and sanitized social environment which lead to a great decline in the no. Of these rodents . These scavengers and opportunistic eaters which used to dwell in the garbage were forced into deep dark bins along with it without any exposure with humans.

Though we have achieved a greater degree of pest control, with all the steps we took for a better place to live in,have reduced the incidence of these infections so much but we are yet to get completely rid of them which is not possible as these minuscule like little devils are an important link of food web and our bio system.

THE FLYING THEORY

With their fuzzy noses and rounded ears, bats are often called "rats with wings" or "flying rodents" by people who misunderstand them. But are they really related to the rodent family? Flatly, no. Bats are not even remotely related to mice or rats.

Still if we talk about the curse they carry it can't be denied that bats too like rats have been at the crux of so many outbreaks most of them being the recent ones.

Bats are the only mammals capable of sustained flight, which makes them pretty special. Vampire bats prefer to feed on livestock, depending on the species. However, they have been known to feed on humans which give us a hint of bats being in the limelight of recent COVID-19 pandemic and other important outbreaks from the past.

But this time our story is a bit different, actually it's all the other way round, it's not because of bats biting humans but humans eating bats that could be a reason of viral transmission.

While bats aren't to blame for everything, they have played a role in transmission of at least 11 viruses (12 including SARS-cov2).

The researchers collected more than 750 samples of saliva and fecal matter from 464 different bats from 11 different species. The new viruses were discovered in three species: the Greater Asiatic yellow house bat, the wrinkle-lipped free-tailed bat and the Hors field's leaf-nosed bat.

According to LiveScience, the six coronaviruses were given new names: PREDICT-CoV-90 (found in the Asiatic yellow house bat), PREDICT-CoV-47 and PREDICT-CoV-82 (found in the wrinkle-lipped free-tailed bat) and PREDICT-CoV-92, -93 and -96 (found in the leaf-nosed bat).It's believed that "thousands of coronaviruses — many of which have yet to be discovered — are present in bats," the statement added.

The unique immune system

Although rodents and all other social animals are known to carry pathogens and transmit them just the way humans do, still, bats in Particular *do carry a lots of viruses.* And that's because of their unique immune system.

Bats are the only mammals who are truly known to fly , gliding is a different thing but flying with flapping of the wings require a enormous amount of energy in the form of ATP, the energy currency of the cell, their mitochondria have developed a unique way of oxidative phosphorylation which allows them to produce excess of ATP to meet there energy demands for flying, but since excess of everything is harmful. Excess of ATP production leads to excess formation of mitochondrial by products called *reactive oxygen species.* These reactive oxygen species are known to cause DNA damage rendering them beyond repair. in normal mammals they are confined within mitochondria.

excess production of them in the bats permeate them to the extra cellular and intracellular surroundings causing a condition known as *oxidative stress.*

Now had it been a normal mammal or organism such an oxidative stress can cause DNA damage and acute inflammatory conditions but bats due to their modifications escape this.

The immune system uses reactive oxygen species to rouse immune cells to action and *kill the bacterial invaders.* They can weaken the cell membranes mess with proteins and even break DNA and because of that they play an important role in chronic inflammatory diseases

Bats' supercharged mitochondria means extremely high levels of oxidative stress which in turn means constantly high levels of DNA damage.

Due to this constant oxidative stress, as genetic studies have found, certain mutations have occurred in bats to boost up their ability to detect and repair the damage DNA.

But DNA damage is also a sign of a viral infection which naturally triggers an immune response but over activated DNA repair mechanisms in the bats mask for the viral infections and hence they fail to show any sign and symptoms like other mammals with virus running in their veins.

But this DNA itself induces a super flare before the advance repair mechanism act which suggests that bats are always in a kind of immune flare. Meaning their immune system is always activated.

Further detailed studies have shown there's a down regulation of a group of proteins called STING proteins (*STimulator of INterferon Genes proteins),* these proteins are one of the ways mammalian cells trigger an inflammatory response when a virus is detected.

In fact they are the only mammals which completely lack genes for PYHIN Proteins, another set of inflammation triggering proteins acting as sensors activated by damaged DNA.

In short, *even though they are widely infected with notoriously deadly viruses, they don't actually seek to get sick from them.*

That's because bats have a hyper vigilant Interferon production systems, meaning as the genomic studies suggest bat cells always have their interferon alpha genes activated.

Out of the native

Bats have been flying since ages and the viral mechanism of their hemodynamics and aerodynamics has been well established for a long time by now then what could be the reason for sudden increase in the infections caused by them?

The answer lies just in front of us, with humans and their curious manipulation of the environment have exposed them to the mankind. Bats have known to limit themselves to caves and forests but interference of intruders like us for the sake of knowledge or savor The taste buds have brought them out of their native habitat and so are the new world viruses . Wild dwellers have now making sighting in the orchards and gardens, eating fruits and transmitting viruses to us.

This also reflects us the need to look into a much neglected debate, *the effect of climate change on the biodiversity.*

Animal exploitation for food with its flags in wet markets across the world is increasing with increasing demand of human to taste new things or new animals to be precise.

While we are focusing on our taste and food one should not forget the bitterness of the outbreak that's going to be served in our plates with a note

"P.S. You have been warned,"

Reservoir of pandemics

This awesome immune system of bats in fact has turned them into a reservoir of so many viruses that are dangerous to humans including Ebola, nipah, corona viruses etc…

There are mounting evidences that the bats were involved in transmitting these diseases to humans either directly or indirectly.

They are also suspected to give us many diseases in the past including mumps and measles.

Bat-borne viruses

Paramyxovirus

The first human outbreak of Nipah virus was in 1998 in Malaysia. It was determined that flying foxes were also the reservoir of the virus, with domestic pigs as the intermediate host between bats and humans. Outbreaks have also occurred in Bangladesh, India, Singapore, and the Philippines.

The *2018 Kerala Nipah virus outbreak* was an outbreak of the Nipah virus in the state of Kerala, India, traced to the fruit bats in the area. The outbreak was localized in Kozhikode and Malappuram districts of Keralaand claimed 17 lives, including that of Mohammed Sabith Ali, the first suspected case. The outbreak was contained and declared over on 10 June 2018.

Lyssaviruses

Unlike most other viruses in the family Rhabdoviridae, which are transmitted by arthropods, lyssaviruses (including the rabies virus) are transmitted by mammals, most frequently through biting. All mammals are susceptible to lyssaviruses, though bats and carnivores are the most common natural reservoirs. The vast majority of human rabies cases are a result of the rabies virus, with only twelve other human cases attributed to other lyssaviruses as of 2015.

Italian scientist Antonio Carini was the first to hypothesize that rabies virus could be transmitted by bats, which he did in 1911.

Bats are the most common source of rabies in humans in North and South America, Western Europe, and Australia.

Filo viruses

Filoviridae is a family of virus containing two genera associated with bats: Marburgvirus and Ebolavirus, which contain the species that cause Marburg virus disease and Ebola virus disease, respectively. Though relatively few disease outbreaks are caused by filoviruses, they are of high concern due to their extreme virulence, or capacity to cause harm to their hosts.

The first outbreaks were in 1976 in South Sudan and Democratic Republic of the Congo.

On 1 August 2018, the world's 10th Ebola outbreak was declared in North Kivu province of the Democratic Republic of the Congo. It was the first Ebola outbreak in a military conflict zone, with thousands of refugees in the area. By November 2018, nearly 200 Congolese had died of Ebola, about half of them from the city of Beni, where armed groups are fighting over the region's mineral wealth, impeding medical relief efforts.

By March 2019, this became the second largest Ebola outbreak ever recorded, with more than 1,000 cases and insecurity continuing to being the major resistance to providing an adequate response.As of 4 June 2019, the WHO reported 2025 confirmed and probable cases with 1357 deaths. In June 2019, two people died of Ebola in neighbouring Uganda.

In July 2019, an infected man travelled to Goma, home to more than two million people. One week later, on 17 July 2019, the WHO declared the Ebola outbreak a global health emergency, the fifth time such a declaration has been made by the organisation.A government spokesman said that half of the Ebola cases are unidentified, and he added that the current outbreak could last up to three years.

India registered its first case of Ebola in 2014.

The virus was later found in the bats of northeast India

Coronaviruses

Bats harbor a great diversity of coronaviruses, with sampling by the EcoHealth Alliance in China alone identifying about 400 new strains of coronavirus.

Several bat coronaviruses are known to be zoonotic, or transmissible to humans, including severe acute respiratory syndrome coronavirus (SARS-CoV) and Middle East respiratory syndrome-related coronavirus (MERS-CoV). Severe acute respiratory syndrome coronavirus 2 (SARS-CoV 2) is another zoonotic coronavirus likely originating in bats.

SARS-CoV causes the disease severe acute respiratory syndrome (SARS) in humans. The first documented case of SARS was in November 2002 in Foshan, China.It became an epidemic, affecting 28 countries around the world with 8,096 cases and 774 deaths.The natural reservoir of SARS-CoV was identified as bats, with the Chinese rufous horseshoe bat considered a particularly strong candidate after a coronavirus was recovered from a colony that had 95% nucleotide sequence similarity to SARS-CoV.

Although India became highly infected due to SARS in 2002-03, but it didn’t claim any lives as it did in other countries.

The first human case of Middle East respiratory syndrome (MERS) was in June 2012 in Jeddah, Saudi Arabia.As of November 2019, 2,494 cases of MERS have been reported in twenty-seven countries, resulting in 858 fatalities.It is believed that MERS-CoV originated in bats, though camels are likely the intermediate host

through which humans became infected. Human-to-human transmission is possible, though does not easily occur.

Covid-19

In the public mind, the origin story of coronavirus seems well fixed: in late 2019 someone at the now world-famous Huanan seafood market in Wuhan was infected with a virus from an animal.

But there is uncertainty about several aspects of the Covid-19 origin story that scientists are trying hard to unravel, including which species passed it to a human. They're trying hard because knowing how a pandemic starts is a key to stopping the next one.

Prof Stephen Turner, head of the department of microbiology at Melbourne's Monash University, says what's most likely is that virus originated in bats.

But that's where his certainty ends, he says

The fact that the virus has infected a tiger in a New York zoo shows how viruses can move around between species, he says. "Understanding the breadth of species this virus can infect is important as it helps us narrow down down where it might have come from."

Scientists say it is highly likely that the virus came from bats but first passed through an intermediary animal in the same way that another coronavirus – the 2002 SARS outbreak – moved from horseshoe bats to cat-like civets before infecting humans.

One animal implicated as an intermediary host between bats and humans is the pangolin. The International Union for Conservation of Nature says they are "the most illegally traded mammal in the world" and are prized for their meat and the claimed medicinal properties of their scales.

Analysis of the first 41 Covid-19 patients in medical journal the Lancet found that 27 of them had direct exposure to the Wuhan market. But the same analysis found that the first known case of the illness did not.

This might be another reason to doubt the established story.

Prof Stanley Perlman, a leading immunologist at the University of Iowa and an expert on previous coronavirus outbreaks that have stemmed from animals, says the idea the link to the Wuhan market is coincidental "cannot be ruled out" but that possibility "seems less likely" because the genetic material of the virus had been found in the market environment.

ICMR researchers screened 78 rectal swabs from Rousettus bats for CoV and has found 4 positive, all four belonging to Kerala

From pteropus bats, 508 rectal swabs were sampled and screened and 21 were detected positive for CoV.

Of 21, 12 belonged to Kerala, 2 to Himachal, 6 to Puducherry and 1 to Tamil Nadu Throwing more light on the burning question of current pandemic origin.

Though the exact origin of Covid-19 is still under question, probablities , investigations it brings back to us the picture of a bat as the crux of the curse affecting the mankind.

III. Summary

While rats were harbinger of death by opportunity and negligence. Bats are grim by choice. Their ability to fly come with a death sentence that we are still to decipher. Flying theory presumptive of bats as finally rodents though proved wrong has pulled various strings together to unleash the possibility of both being relatives of death.

Rats were the pests that were tamed and controlled but their flying relatives can't be confined because of there wings and delicacy in food.

The ways to fight with the current situation lies not only in the prevention but a study and discussion of bats as the heart of the cause, who know perhaps studying more about their immune system can open to us a world of all the immense possibilities to pull us out of this global emergency or at least help us to prepare for the worse.

References

Web-links

[1]. https://www.history.com/topics/middle-ages/black-death
[2]. https://www.cdc.gov/rodents/diseases/direct.html
[3]. https://www.cdc.gov/rodents/cleaning/index.html
[4]. https://www.lloydpest.com/blog/rats-the-deadly-diseases-they-carry/
[5]. https://www.quora.com/Why-do-rodents-carry-so-many-diseases
[6]. https://www.who.int/csr/don/archive/country/ind/en/
[7]. https://www.healio.com/infectious-disease/emerging-diseases/news/online/%7B4ac1aa3e-b895-4216-82c3-4d0797938be2%7D/ebola-marburg-viruses-circulate-among-bats-in-india
[8]. https://www.nhp.gov.in/disease/respiratory/respiratory-tract/severe-acute-respiratory-syndrome-sars
[9]. https://www.theguardian.com/world/2020/apr/15/how-did-the-coronavirus-start-where-did-it-come-from-how-did-it-spread-humans-was-it-really-bats-pangolins-wuhan-animal-market
[10]. https://youtu.be/iJ2jDPgvbTY
[11]. https://youtu.be/Q5sP6LuFd9c
[12]. https://massivesci.com/articles/vampire-bats-socializing-food-sharing-grooming/
[13]. https://nypost.com/2020/04/13/researchers-find-6-new-coronaviruses-in-bats/
[14]. https://www.news18.com/news/india/in-a-first-coronaviruses-found-in-two-species-of-indian-bats-icmr-niv-study-2577583.html
[15]. https://en.wikipedia.org/wiki/Bubonic_plague
[16]. https://en.wikipedia.org/wiki/Black_Death
[17]. https://en.wikipedia.org/wiki/Bat-borne_virus
[18]. https://en.wikipedia.org/wiki/2018_Nipah_virus_outbreak_in_Kerala

Newspapers and magazines

- The Guardian
- The Hindu
- The Times of India
- The Economic times
- The Tribune
- The Indian express
- The Hindustan times
- Lancelet
- Live science
- The nature

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